UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Agricultural Engineering
S. H. McCrory, Chief

A REPORT UPON THE DAMAGE CAUSED BY FLOODS TO AGRICULTURAL CROPS IN THE MISSOURI RIVER BOTTOMS BETWEEN ITS MOUTH AND KANSAS CITY, MISSOURI FROM 1903 TO 1935 INCLUSIVE.

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Prepared under the direction of Lewis A. Jones, Chief
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Introduction

This report, made at the request of the Mississippi Valley Committee, United States Department of the Interior, presents the results of an investigation of the crop damages incurred by floods in the Missouri River bottoms between the mouth of the river and Kansas City, Missouri. The topographical characteristics of the valley, the number of acres flooded for the principal floods, and the damages incurred in money value are given. The study includes only the floods from 1903 through 1935 since it is impracticable to get even a close approximation of the area in cultivation for previous years. The report describes the methods used in obtaining the data, the assumptions made in the study, and gives a summary of the actual losses to the land owners.

Description of Valley

The Missouri River bottomsvary from two to five miles in width. In general the river follows the bluff, first on one side of the valley and then on the other. Below Boonville the valley is quite narrow, averaging two miles in width. Above Boonville the valley is wider, reaching a width of from five to six miles near Carrollton. The bottom land is located in twenty counties in Missouri, ten on the south side and ten on the north side of the River. There is approximately 3-1/4 times as much bottom land on the north side of the River as there is on the south side. The counties of Chariton,

Carroll and Ray contain about one-third of the total area of bottom land. Of these counties, Carroll County has the greatest area with Ray County a close second (see accompanying map). St. Charles County below St. Charles contains a large area which is affected by both Missouri River and Mississippi River high waters.

During the past 30 years numbrous levee districts have been formed in various sections of the bottom, the major number being above Boonville since this section is more favorable for levee districts. It is impractical to enumbrate all of the districts in this report. However, it is significant that for most of the major floods, nearly all the levees failed to give the desired protection.

Practically the entire valley is in cultivation, the amount of wooded area being quite small. Much of the bottom land, notably that in St. Charles and Warren Counties, has been in cultivation since before 1790. The former burial ground for Daniel Boone is near Marthasville in Warren County. Mr. Oscar Johannaber occupies a two-story log house built in 1790 by Daniel Boone's son-in-law, and Mr. Johannaber's farm was originally cultivated by Boone's son-in-law.

The bottom land is very fertile and raises excellent crops. The 1934 crops in the bottom were the best seen by the writer anywhere during that year even though the rainfall was below normal.

Principal Floods which Caused Damage to Crops.

In the last 32 years ten floods have occurred along the Missouri River in Missouri which have caused material damage to crops. These floods and the time of their peak at Kansas City are as follows: June 2, 1903; June 15, 1908; July 13, 1909; July 21, 1915; June 17, 1917; April 12 and July 13, 1922; June 21, 1924; April 21 and June 13, 1927; June 5, 1929, and June 7, 1935. Naturally, the time of the peak of the floods at Waverly, Boonville, Herman, and St. Charles occurred from one to four days later than the peak at Kansas City. Floods of minor importance occurred in 1904, 1912, and 1928 but these did not reach bank-full stage and overflowed only very low land and into the bottoms of cleared depressions. The 1903 flood covered the entire river valley and was the most destructive in the last 32 years, so far as area is concerned. The 1935 flood below Boonville was the highest since the 1903 flood. Above Boonville its peak was exceeded by two or three other floods.

The major floods occurred during the crop-growing season and naturally were destructive in their effects. Certain floods were prolonged, notably that of 1915 which lasted about four months and even prevented the growing of soft feed corn. Some floods occurred early enough that corn planted in July could be raised in sufficient quantity for feeding purposes; the corn did not mature sufficiently for marketing.

Three major floods occurred previous to 1905, these being in 1844, 1881, and 1892. These floods are not included in this report since no data on flood heights throughout the valley are available and information on actual areas in cultivation is lacking.

It is a significant fact that in interviews with a great many land owners, none consider the possibility of floods a menace. All of the farmers are anxious to keep their bottom land and any they can stand a flood once in three years and still be ahead of the hill farmer. Instances have occurred where hill farmers have even fought for an opportunity to rent bottom land.

Methods of Securing Data.

To determine the damage to crops caused by floods information was sought on areas flooded and yields of various crops grown. It was originally planned to consult all county officials, particularly agricultural agents and county engineers, as well as newspaper files and landowners. The results obtained in these first two lines were disappointing. Few county engineers could give much information and most of the agricultural agents were new men and know little of damages caused by past floods. Other county officials were unable to offer information of much value. Newspaper files gave little of the kind of data desired.

The best information on losses sustained and yields of crops grown was obtained by interviews with farmers. Quite a few of these landowners have lived in the valley for at least 35 years; one, a Mr. Tony Neuther at Dutzow has lived in the bottom for over 58 years. While these landowners knew their own losses and average yields of various crops, as a rule they were unable to give the losses in terms of money.

It was planned to determine the actual areas flooded by interviewing all the farmers. It was soon apparent that this procedure would be too time-consuming since many of the farmers were absent from home at the time of the inspection and many were unable to remember the actual acreage covered and total losses sustained. The procedure finally adopted was to interview as many landowners as possible and get their viewpoint in regard to floods. Information obtained from them on average crop yields was very valuable and it was surprising to note how uniformly the values of the average crop yields ran throughout the valley. It was soon

realized that it would be impossible to get from farmers alone the total areas flooded. Fortunately the War Department has made an accurate topographical map of the entire river valley showing two-foot contours in the flood plain. Gage readings of flood heights have been kept at St. Charles, Hermann, Boonville, Waverly, and Kansas City. A great many readings of the 1903 flood stage were obtained by the War Department in their survey. Hence it was possible to plot a profile showing the flood line for the 1903 flood. The flood profiles for the other floods were determined by assuming the flood flow line was uniform between consecutive gages.

About 5-1/2 weeks in May and June, 1934, were spent in the field covering about 360 miles of river valley. About ten days in August, 1935, were devoted to field investigations, getting data on the 1935 flood. Some seven weeks were spent in the office measuring flooded areas from the War Department maps and preparing the estimates and report. It is believed that if reliable topographic maps had not been available, the field work would have taken at least six months for one person to obtain any reliable estimate of the areas overflowed by the different floods.

It is interesting to note that the distance measured along the 1930 thalweg from the mouth to the C. B. & Q. R. R. bridge in Kansas City, Mo., is given by the War Department as 390.7 miles while the distance measured along the center of the present channel shown on the topographic maps is 360 miles.

Assumptions Made in Determining Losses.

In the determination of losses caused by floods, certain assumptions

had to be made. It was assumed that the cleared areas as shown by the War Department maps from their plane table survey of 1931 existed for all of the floods studied. It was also assumed that the flood flow line was uniform between consecutive gages for all floods except the 1903 flood for which a large number of flood stages were recorded. While it is realized that this would not be strictly true, it is believed that no serious error is introduced through this assumption. The 1903 flood covered the entire valley, hence it was simple to determine the area submerged during this flood. The submerged areas for the other floods have been determined as accurately as it is possible to get them.

A study was made of the effect of accretion, due to the shifting of the river channel, on the total amount of land under cultivation. Newly-made land seldom is in suitable condition for cultivation and it must lie dormant for a time before it can be tilled. After making many measurements of such areas it was decided that the effect of accretion is small since the land added to one side of the river is usually taken from the other side. Furthermore the problem of land formed by accretion is of even less importance than formerly since the War Department has recently completed a very extensive channel regulation system throughout the entire valley. Therefore accretion has little effect on the total amount of land under cultivation from year to year.

A small amount of trucking is carried on in the valley, principally adjacent to the larger towns. Likewise, in a few areas, such as those near Berwen, Waverly, and Kansas City, potatoes are raised for the market. A comparatively few landowners raise alfalfa hay for the

market, each one usually having about 40 to 50 acres. Some farmers raise a few acres of oats principally for feed. Another factor which enters into the estimate is the area devoted to pasture and farm buildings. Ordinarily though, timbered areas, where available, are used for pasture.

While a few farmers suffered losses to farm buildings such damages are difficult to evaluate. No attempt has been made to include damages to railroads and highways. The estimates given in this report are losses in crops only.

The following general assumptions have been made:

1. The average farm contains about 125 acres.
2. Twenty acres of each farm are devoted to pasture and buildings.
3. Five acres are given over to alfalfa (used on the farm only).
4. The remaining acreage is devoted equally to corn and wheat.

It is assumed that corn averages 40 bushels per acre and wheat 20 bushels per acre. Four cuttings of alfalfa are made each year averaging about one ton per cutting per acre. Unit grain prices used for the years in which the floods occurred were taken from the Missouri records in U. S. Department of Agriculture Statistical Bulletin No. 15. The average prices for 1903, 1907, and 1929 were obtained from the Board of Trade office in Iowa City. The market prices on October 2, 1935, were used in the 1935 flood damage estimate.

The cultivated area flooded by the 1935 high water was determined somewhat differently from those for the previous floods. A considerable amount of the flooded land was not under cultivation because the owners

had signed [illegible] agreements for crop reduction. The total area flooded by the 1935 flood was determined from the topographic maps. From interviews with county agricultural agents it was found that of the total number of landowners about 75 percent signed crop-reduction agreements. For corn, the crop-reduction was taken as 21 percent and for wheat, 20 percent. The actual area under cultivation in June, 1935, was determined by using the above figures.

The following unit values used in this report with certain exceptions were taken as the average price paid for that crop from the time the crop was harvested until the harvest of the next year.

Year	Wheat	Corn	Alfalfa
	Price per bushel		Price per ton
1903	0.82	0.47	11.00
1908	1.00	0.66	11.20
1909	1.06	.64	11.70
1915	1.04	.70	11.85
1917	2.08	1.45	19.82
1922	1.04	.72	13.13
1924	1.44	1.07	15.55
1927	1.45	.99	13.00
1929	1.19	.88	15.00
1935	1.00	.60	14.50

* Estimated.

RESULTS OF INVESTIGATION

The total acreage flooded and the losses caused by each flood are as follows:

Date of Flood	Area Overflowed Acres	Loss due to Crops
1903	358,200	$ 5,674,000.
1906	312,900	4,368,000.
1909	351,300	6,812,000.
1915	262,500	5,817,000.
1917	240,800	10,295,000.
1922	110,000	2,372,000.
1924	67,300	2,095,000.
1927	288,700	8,858,000.
1929	138,000	3,477,000.
1935	125,300	2,869,000.
	2,299,800	$ 54,775,000.

While the above loss does not include that due to buildings, live stock, and highways, the amounts of these losses are insignificant as compared to loss of crops. Very few farms suffered loss to buildings and live stock. The damage to highways is assessed against all the landowners so that the individual farmer's monetary loss in highways is quite small.

CONCLUSION

There have been 10 floods in the last 32 years or one flood about every 3.2 years. This figure seems to tally with the opinion of the bottom farmer that he can stand a flood once in every three years and still make a living. The total area flooded in all these ten floods is about 2,299,800 acres, while the total crop loss is $54,775,000.

The average loss per overflowed farm for these ten floods is about $297.75 for each flood or a loss to each landowner of about [illegible] every year for the last 32 years. That is, each farmer in the last 32 years has sustained a loss of 93 cents per acre per year for each acre under cultivation. Thus it can readily be seen why the bottom farmer does not worry particularly about floods even though a considerable number of levee districts have been built.

Future floods of moderate size probably will not reach the peaks they have in the past because of the storage facilities at the Bagnell Dam on the Osage River in Missouri and at the Fort Peck, Montana dam now being built on the Missouri River. The Bagnell dam and reservoir already have influenced the magnitude of the floods below Osage City at the mouth of the Osage. The following flood gage heights and discharges at Tuscumbia on the Osage River show the flashy characteristics of the Osage.

Date of Flood	Tuscumbia Gage Referred to Present Gage	Discharge c.f.s.
1844	42.19	145,000
Feb. 1882	37.64	110,000
Dec. 1895	38.86	117,000
Apr. 1922	37.7	110,000
Apr. 1927	36.8	106,000
May 1929	36.9	106,000

Since the Osage project started operation in the fall of 1931, there have been only two floods of sizeable proportion on the Osage, one in December, 1932 and one in May, 1935. In the December flood the natural inflow to the reservoir reached a crest of 84,000 c.f.s.

yet the flow below the dam reached a crest of only 30,000 c.f.s. In the May, 1933 flood the natural inflow to the reservoir reached 85,000 c.f.s. but the crest flow below the dam was only 57,000 c.f.s. Out of a total of 4,530,000 sec. ft. days inflow reaching the reservoir up to the first of 1934, only 520,000 sec. ft. days flow, or 11.5% has been spilled over the dam. Spill has occurred on only 38 days out of the entire period of operation to 1934. The highest stage at Tuscumbia since the dam was built has been only 23.3 feet. Mr. Albien Davis, Chief Hydraulic Engineer of the Union Electric Light & Power Company, St. Louis, which controls Bagnell Dam, states that on extreme floods on the Osage he does not expect much difference between conditions prior to the dam and subsequent.

The War Department predicts that operation of the Fort Peck reservoir will reduce flood peaks at Kansas City from 1 to 3.5 feet.

Thus it will be seen that operation of these two reservoirs will ameliorate to some extent flood conditions in the Missouri River bottoms.